

WHAT IS CLAIMED IS:

1. A pattern inspection method which scans the inspected pattern formed on a substrate according to the design data with the laser beam and receives the light passing through said substrate with the light receiving device and, from the pattern information obtained by  
5 said light receiving device, generates the image of the inspected pattern and, for coincidence between this image and the reference data obtained by imaging of said design data, corrects said reference data to generate  
10 the reference image and compares the image of said inspected pattern and the reference image to detect any defects of the inspected pattern wherein

said reference image generation being executed by determination of the edge boundary condition  
15 showing the gray level corresponding to the pattern edge position through convolution operation of the optical point spread function corresponding to the laser beam strength and said inspected pattern image as well as detection according to said edge boundary condition of  
20 the edge position in said inspected pattern by the unit of sub-pixels.

2. A pattern inspection method which scans the inspected pattern formed on a substrate according to the design data with the laser beam and receives the light

5 passed through said substrate with the light receiving  
device and, from the pattern information obtained by  
said light receiving device, generates the image of the  
inspected pattern and, for coincidence between this  
image and the reference data obtained by imaging of said  
design data, corrects said reference data to generate  
10 the reference image and compares the image of said  
inspected pattern and the reference image to detect any  
defects of the inspected pattern wherein

said reference image generation comprising  
provision to each pixel of sub-pixels dividing  
15 the pixel to form a matrix and calculation of the gray  
level of the pixel based on the number of sub-pixels  
belonging to the pattern developed in each pixel and  
calculation of the pattern width for said  
inspected pattern and for the reference data at the  
20 position at the corresponding position by treating the  
number obtained by dividing said gray level by the gray  
level step count as the width of the pattern developed  
in that pixel.

3. A reference image preparation method as set forth  
in Claim 2 wherein

the gray level of each pixel is calculated from  
the number of sub-pixels belonging to said inspected  
5 pattern and, treating the count obtained by dividing  
this gray level by the gray level step count as the

pattern width of the inspected pattern developed in the pixel, the pattern width of said inspected pattern is calculated and

10           the gray level of each pixel is calculated from the number of sub-pixels belonging to said reference data pattern and, treating the count obtained by dividing this gray level by the gray level step count as the pattern width of the reference data developed in the  
15           pixel, the pattern width of said reference data is calculated.

4.           A reference image preparation method as set forth in Claim 3 wherein

              the pattern correction width of said reference data is calculated from the difference between the  
5           pattern width of said inspected pattern and the pattern width of the reference data.

5.           A pattern inspection device comprising:

              a scanning means which scans the inspected pattern formed on the substrate according to the design data with the laser beam and receives the light passing  
5           through said substrate with the light receiving device,  
              a photoelectric image processing means which generates the image of the inspected pattern from the pattern information obtained by the light receiving device in said scanning means,

10           a reference image generation means which  
generates the reference image with correcting said  
reference data so that the positions of the image of  
said inspected pattern and the reference data obtained  
by imaging of said design data coincide,

15           a comparison means which compares the image of  
said inspected pattern and the reference image to detect  
any defect in the inspected pattern, and

          an edge position detection means which determines  
the edge boundary condition showing the gray level  
20           corresponding to the pattern edge position through  
convolution operation of the optical point spread  
function corresponding to the laser beam strength and  
the image of said inspected pattern and detects the edge  
position of the inspected pattern by the unit of sub-  
25           pixels according to said edge boundary condition.

6.       A pattern inspection device comprising:

          a scanning means which scans the inspected  
pattern formed on the substrate according to the design  
data with the laser beam and receives the light passing  
5           through said substrate with the light receiving device,

          a photoelectric image processing means which  
generates the image of the inspected pattern from the  
pattern information obtained by the light receiving  
device in said scanning means,

10           a reference image generation means which

generates the reference image with correcting said reference data so that the positions of the image of said inspected pattern and the reference data obtained by imaging of said design data coincide,

15           a comparison means which compares the image of said inspected pattern and the reference image to detect any defect in the inspected pattern, and

          a pattern width calculation means which provides each pixel with sub-pixels dividing the pixel into a  
20           matrix and calculates the gray level of each pixel based on the number of sub-pixels belonging to the pattern developed in each pixel and, with treating the count obtained by dividing this gray level by the gray level step count as the width of the pattern developed in the  
25           pixel, calculates the pattern width of said inspected pattern and the pattern width of the reference data at the corresponding position respectively.

7.        A pattern inspection device as set forth in Claim 6 wherein

          said pattern width calculation means  
          calculates the gray level of each pixel from the  
5           number of sub-pixels belonging to said inspected pattern and, with treating the count obtained by dividing this gray level by the gray level step count as the pattern width of the inspected pattern developed in the pixel, calculate the pattern width of said inspected pattern,

10 and also calculates the gray level of each pixel from  
the number of sub-pixels belonging to the pattern of  
said reference data and, with treating the count  
obtained by dividing this gray level by the gray level  
step count as the pattern width of the reference data  
15 developed in the pixel, calculates the pattern width of  
said reference data.

8. A pattern inspection device as set forth in Claim  
7 wherein

said pattern width calculation means  
calculates the pattern correction width of said  
5 reference data from the difference between the pattern  
width of said inspected pattern and the pattern width of  
the reference data.

9. A computer readable memory storing a pattern  
inspection program which, by controlling the computer,  
scans the inspected pattern formed on the substrate  
according to the design data with the laser beam and  
5 receives the light passing through said substrate with  
the light receiving device and generates the image of  
the inspected pattern according to the pattern  
information received by the light receiving device and,  
for coincidence of this image and the reference data  
10 position obtained by imaging of said design data,  
corrects said reference data to generate the reference

image and compares the image of the inspected pattern and the reference image to detect any defect in the inspected pattern wherein

15           said pattern inspection program executes,  
          in said reference image generation process,  
          determination of the edge boundary condition  
showing the gray level corresponding to the pattern edge  
position by convolution operation of the optical point  
20           spread function corresponding to the laser beam strength  
and the image of said inspected pattern and  
          detection of the edge position of said inspected  
pattern by the unit of sub-pixels according to said edge  
boundary condition.

25  
10.       A computer readable memory storing a pattern  
inspection program which, by controlling the computer,  
scans the inspected pattern formed on the substrate  
according to the design data using the laser beam,  
5       receives the light passing from said substrate with the  
light receiving device, generates the image of the  
inspected pattern based on the pattern information  
obtained by the light receiving device and, for position  
coincidence between this image and the reference data  
10       obtained by imaging of said design data, corrects said  
reference data and generates the reference image, and  
compares the image of said inspected pattern and the  
reference image to detect defects of the inspected

pattern wherein

15           said pattern inspection program executes,  
            in said reference image generation,  
            provision of sub-pixels dividing the pixel as a  
matrix to each pixel and calculation of the gray level  
for each pixel based on the number of sub-pixels  
20           belonging to the pattern developed in each pixel an  
            calculation of the pattern width of said  
inspected pattern and the pattern width of the reference  
data at the corresponding position respectively with  
treating the count obtained by dividing said gray level  
25           by the gray level step count as the width of the pattern  
developed in the pixel.

11.       A computer readable memory storing the pattern  
inspection program as set forth in Claim 10 wherein

            said pattern inspection program  
            calculates the gray level of each pixel from the  
5           number of sub-pixels belonging to said inspected pattern  
and, with treating the count obtained by dividing this  
gray level by the gray level step count as the pattern  
width of the inspected pattern developed in the pixel,  
calculates the pattern width of said inspected pattern,  
10           and also calculates the gray level of each pixel from  
the number of sub-pixels belonging to the pattern of  
said reference data and, with treating the count  
obtained by dividing this gray level by the gray level



15       step count as the pattern width of the reference data  
developed in the pixel, calculates the pattern width of  
said reference data.

12.       A computer readable memory storing the pattern  
inspection program as set forth in Claim 11 wherein  
          said pattern inspection program  
          calculates the pattern correction width of said  
5       reference data from the difference between the pattern  
width of said inspected pattern and the pattern width of  
the reference data.